

# DYNAMIC VARIATION OF NITROGEN CONTENT IN THE SECOND SONGHUA RIVER<sup>①</sup>

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**ABSTRACT:** The space-time variation laws of nitrogen content in different river sections, water periods and years in the Second Songhua River in China is described in detail. The results show that there is direct relation between the nitrogen content variation in river water and that in wastewater from cities and runoff water of both banks of the river. Nitrate and nitrite contents in water in flood period are higher than that in mid and low water periods. In flood period, nitrate content in water increases gradually with the extension of river section, ammonia content in polluted river section is higher than that in unpolluted river section. Nitrate and nitrite contents in water in the flood, mid and low water periods from 1985 to 1989 were slightly higher than that from 1980 to 1984 and from 1990 to 1994, ammonia content in water increased annually.

**KEY WORDS:** nitrogen content, space-time variation law, the Second Songhua River

The water pollution in the Second Songhua River has been paid much attention to for a long time. Many environmental scientists have done a lot of research work on it, but most of research contents were to focus on heavy metal pollution and organic pollution in water, and little about nitrogen(Fu *et al.*, 1992; Wang *et al.*, 1982, 1992; Xu *et al.*, 1992). The nitrogen content is an important index of water quality, especially the ammonia and nitrite, which are sensitive to water quality. So, it is necessary to make a systematic analysis and assessment on the dynamic variation of nitrogen content in the Second Songhua River.

## 1 SELECTION OF MONITORING SECTION AND MONITORING PERIOD

Five sections were selected on the trunk stream of the Second Songhua River(Fig. 1). The monitor-

ing period for each section is low water period (February), mid water period (December) and flood period (August), respectively. The monitoring time was from 1980 to 1994.

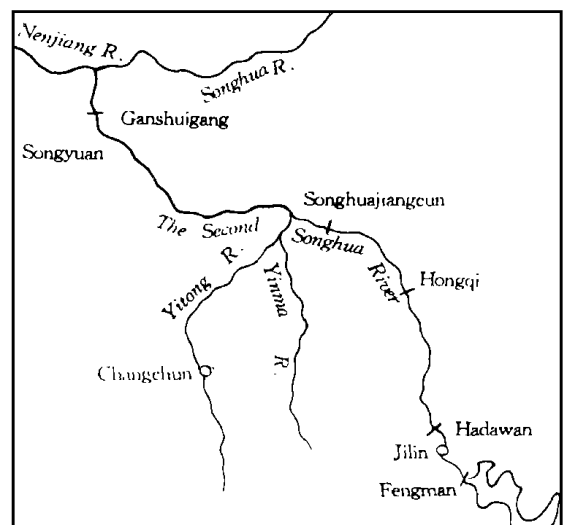


Fig. 1 Sketch of monitoring sections

## 2 SPACE-TIME VARIATION LAWS OF NITRATE

### 2.1 The Variation of Nitrate Content in Water at the Same Section in Different Water Periods

At Fengman section, the change range of  $\text{NO}_3\text{-N}$  content is from 0.44 mg/L to 0.62 mg/L in mid and low water periods, from 0.27 mg/L to 0.36 mg/L in flood period. The latter is obviously lower than the former. This implies that  $\text{NO}_3\text{-N}$  content is controlled by the volume of flow in this section.

At Hadawan section,  $\text{NO}_3\text{-N}$  content in flood period is obviously higher than that in low and mid water periods. The main cause is that the river section receives a large quantity of surface runoff with nitrogen from urban and suburban areas.

At each of 3 sections in the lower reaches of the river, the variation law is similar, that is,  $\text{NO}_3\text{-N}$  content in flood period is higher than that in low and mid water periods (Fig. 2). This implies that the nitrogen fertilizer coming from the paddy field and dry-farming field of both banks of river is one of the main causes that make the  $\text{NO}_3\text{-N}$  content increase in flood period.

### 2.2 The Variation of Nitrate Content in Water in the Same Water Period at Different Sections

In low water period,  $\text{NO}_3\text{-N}$  content at Fengman section is slightly higher than that at Hadawan section and Hongqi section.  $\text{NO}_3\text{-N}$  content doesn't increase at the latter two sections, though they have received a large quantity of living and industrial wastewater from Jilin City. The cause is that the river section doesn't freeze in winter from Fengman section to Hadawan section (30 km). A large oxygenated area forms in the section, so  $\text{NO}_3\text{-N}$  decomposed rate is high.

But from Hongqi section to Ganshuigang section, the  $\text{NO}_3\text{-N}$  content tends to increase gradually (Fig. 2). The reason is that the living and industrial wastewater of Changchun City and Songyuan City en-

ters the river here. In mid water period, the variation of  $\text{NO}_3\text{-N}$  content at each section is similar to that in low water period. In flood period,  $\text{NO}_3\text{-N}$  content increases gradually from Fengman section to Ganshuigang section (Fig. 2). The first reason is the confluence of living and industrial wastewater, the second reason is that the nitrogen fertilizer from the paddy field and dry farmland on both banks of the river flows into the river with surface runoff. This phenomenon is agreement with the highest content of suspend solid in water in flood period.

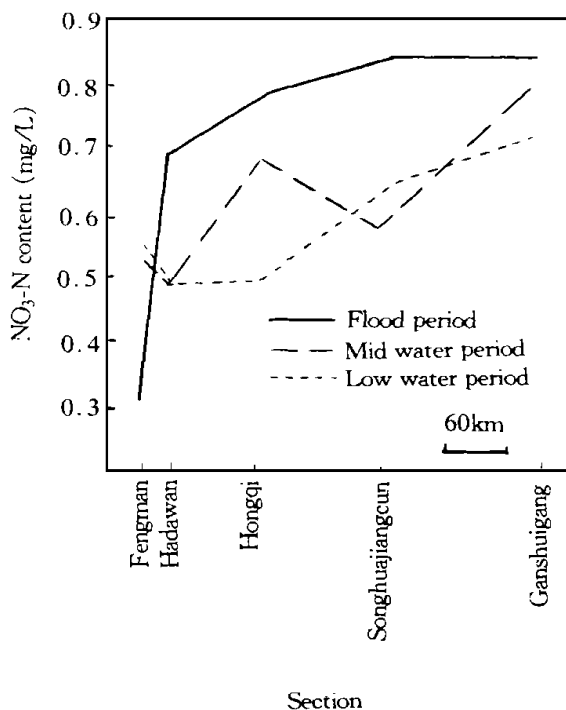


Fig. 2 The variation of  $\text{NO}_3\text{-N}$  content at five river sections of the Second Songhua River in three water periods

### 2.3 The Annual Variation of Nitrate Content in the Water

In order to entirely know annual variation laws of  $\text{NO}_3\text{-N}$  content,  $\text{NO}_3\text{-N}$  contents in different years and different water periods are shown in Fig. 3. The figure indicates that the  $\text{NO}_3\text{-N}$  content in the period from 1985 to 1989 was higher slightly than that in the other two periods.

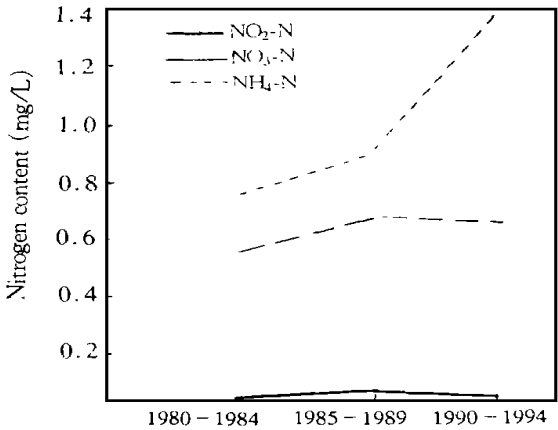


Fig. 3 The annual variation of nitrogen content in water in the Second Songhua River

3 SPACE-TIME VARIATION LAWS OF NITRITE

3.1 The Variation of Nitrite Content in Water at the Same Section in Different Water Periods

As shown in Fig. 4, at Fengman section, the difference of NO<sub>2</sub>-N content is little in three water periods, and NO<sub>2</sub>-N content in flood period is slightly higher than that in low and mid water periods. The

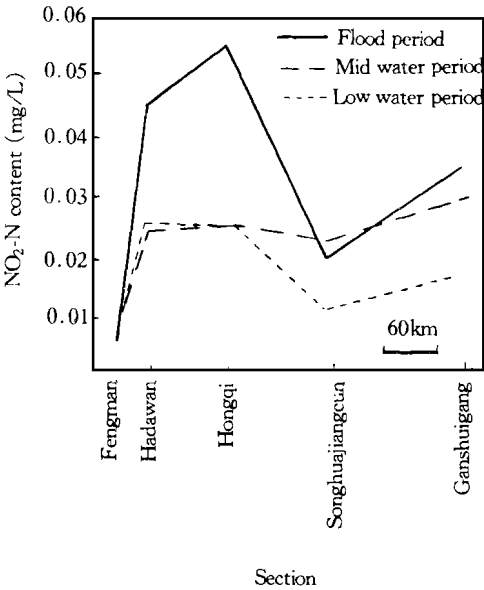


Fig. 4 The variation of NO<sub>2</sub>-N content at five river sections of the Second Songhua River in three water periods

variation law of NO<sub>2</sub>-N content is not similar to that of NO<sub>3</sub>-N content at this section.

At Hadawan section, NO<sub>2</sub>-N content in flood period is obviously higher than that in low and mid water periods. This implies that the wastewater from Jilin City and runoff water contains lots of NO<sub>2</sub>-N.

At Hongqi section, NO<sub>2</sub>-N content in flood period is higher than that in low and mid water periods too. The cause is that the industrial wastewater and farm water with NO<sub>2</sub>-N flow into the river.

At Songhuajiangcun section, NO<sub>2</sub>-N contents in flood and mid water periods are similar and higher than that in low water period, but they are 2.3, 0.3, 2.9 times lower than that at Hongqi section in flood, mid and low water periods, respectively.

At Ganshuigang section, NO<sub>2</sub>-N content in flood period is higher than that in low and mid water periods. This is because that the wastewater from Songyuan City and runoff water contains a certain quantity of NO<sub>2</sub>-N.

3.2 The Variation of NO<sub>2</sub>-N in Water in the Same Water Period at Different Sections

In low water period, NO<sub>2</sub>-N content at Hadawan section and Hongqi section is similar and 3.1 times higher than that at Fengman section. The reason is that Hadawan and Hongqi sections accept industrial and living wastewater from Jilin City and wastewater from sugar refinery which located between Jilin City and Hadawan.

At Songhuajiangcun section, NO<sub>2</sub>-N content is about 2.3 times lower than that at two sections of upper reaches, but higher than that at Fengman section. The main reason is that there is no industrial and living wastewater discharged this section, being the result of the river self-purification.

At Ganshuigang section, the cause of NO<sub>2</sub>-N content increasing is that the section receives the industrial and living wastewater from Songyuan City. NO<sub>2</sub>-N content variation law in flood period is similar to that in low and mid water periods at different sections (Fig. 4), but its content is higher than that in

low and mid water periods obviously. The main reason is the effect of runoff with  $\text{NO}_2\text{-N}$  in rainy season besides the effect of the industrial and living wastewater.

### 3.3 The Annual Variation of $\text{NO}_2\text{-N}$ Content

The annual variation of  $\text{NO}_2\text{-N}$  content in water is not obviously, but  $\text{NO}_2\text{-N}$  content in the period from 1985 to 1989 is slightly higher than that of the other two periods (Fig. 3). The result is similar to the annual variation of  $\text{NO}_3\text{-N}$  content.

## 4 SPACE-TIME VARIATION LAWS OF AMMONIA

### 4.1 The Variation of Ammonia Content in Water at the Same Section in Different Water Periods

As shown in Fig. 5, at Fengman section, ammonia content in water is relatively low and the content in water in mid water period is slightly higher than that in low water period and flood period.

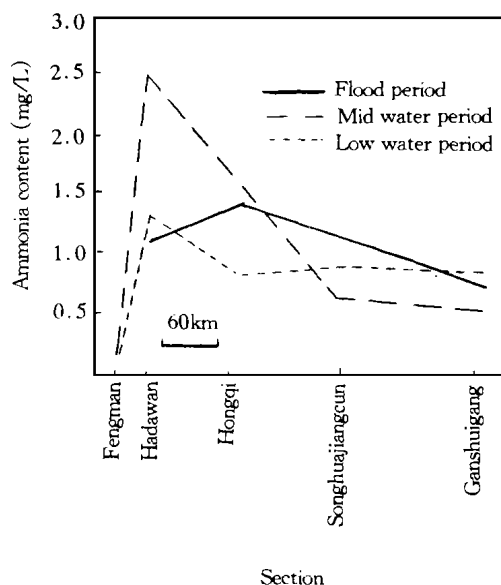


Fig.5 The variation of ammonia content at five river sections of the Second Songhua River in three water periods

law is similar to that at Fengman section, but the content increases obviously. This implies that the wastewater of Jilin City most greatly affect ammonia content variation.

At Hongqi section, ammonia content is higher than that of Hadawan section, though the content in flood period is lower than that in mid water period. The result is caused by the ammonia in wastewater from sugar refinery and nitrogen fertilizer from paddy field and dry-farming field of both banks in the river section joining the river.

At Songhuajiangcun section, ammonia content in 3 water periods is relatively low, but the content in flood period is obviously higher than that in mid and low water periods. This is because the nitrogen fertilizer of farmland leaches into the river.

At Ganshuigang section, ammonia content in low water period is higher than that of mid water period and flood period. It has relation to the amount of wastewater discharged by Songyuan City and the volume of flow.

### 4.2 The Variation of Ammonia Content in Water in the Same Water Period at Different Sections

Ammonia content in water at all sections of lower reaches of Hadawan section is higher than that of Fengman section, especially at Hadawan section, it is the highest compared with that of all other sections. The main reason is the wastewater from Jilin City discharging into the river. In low and mid water periods, ammonia content decreases gradually from Hadawan section to Ganshuigang section. In flood period, the content reaches the highest value at Hongqi section and then decreases gradually.

### 4.3 The Annual Variation of Ammonia Content in Water

The yearly variation of ammonia content in water of the Second Songhua River is very apparent. The content in water in the period from 1980 to 1984 is 0.77 mg/L, increasing to 0.90 mg/L in the period

from 1985 to 1989, and up to 1.37 mg/L in the period from 1990 to 1994. This indicates that the yearly variation of ammonia content in water increases gradually (Fig. 3). So, from now on, in the management work of the pollution controlling of the Second Songhua River, it is necessary to limit discharge amount of ammonia in wastewater.

## 5 CONCLUSIONS

(1)  $\text{NO}_3\text{-N}$  content in water increases gradually with the extension of the river in different water periods at all sections except Fengman section.  $\text{NO}_3\text{-N}$  content in flood period is higher than that of low and mid water periods at the same section.  $\text{NO}_3\text{-N}$  content in water in the period from 1985 to 1989 is higher than that in the periods from 1980 to 1984 and from 1990 to 1994.

(2)  $\text{NO}_2\text{-N}$  content increases obviously at the section receiving industrial and living wastewater at different sections. At the same section,  $\text{NO}_2\text{-N}$  content in flood period is higher than that in low and mid water periods.  $\text{NO}_2\text{-N}$  content in water in the period from 1985 to 1989 was slightly higher than that in the other two periods.

(3) Ammonia content variation is affected appar-

ently by the wastewater from city. It is up to the highest value at the polluted section (Hadawan section) and then decreases gradually with the extension of the river. From 1980 to 1994, the yearly variation of ammonia content in water was intended to increase gradually with years.

(4) One of the main reasons of high ammonia content in water is nitrogen fertilizer which is discharged into the Second Songhua River with surface runoff from paddy field and dry farmland on both banks of the river. Nitrogen content in the Second Songhua River doesn't exceed the standard of its water function.

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